AD 767 325

MONTEREY, CALIFORNIA 93940

Center for Naval Analyses
an affiliate of the University of Rochester

Research Contribution 247

Methodology for Using Draft Lottery Data to Estimate True Volunteers

Institute of Naval Studies

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

02 024700.00

Center for Naval Analyses
an affiliate of the University of Rochester

1401 Wilson Boulevard Arlington, Virginia 22209 703/524-9400

An Equal Opportunity Employer

1 Oct 1973

MEMORANDUM FOR DISTRIBUTION LIST

Subj: Center for Naval Analyses Research Contribution 247; forwarding of

Encl: (1) CRC 247, "Methodology for Using Draft Lottery Data to Estimate True Volunteers," Christopher Jehn and LCdr. H. E. Carroll II, USN, May 1973

1. Enclosure (1) is forwarded as a matter of possible interest. The co-author is one of a select number of naval officers and enlisted men with advanced degrees who, through a unique contract provision, is assigned to CNA for a normal tour of shore duty to participate in the Navy Study Program.

2. Research Contributions are distributed for their potential value in other studies and analyses. They do not necessarily represent the opinion of the Department of the Navy.

3. This Research Contribution is approved for public release.

Herschel Kanter

HERSCHEL E. KANTER
Director
Institute of Naval Studies

Distribution List:
Reverse page

Subj: Center for Naval Analyses Research Contribution 247; forwarding of

---

DISTRIBUTION LIST

Ass't Secretary of the Navy (Manpower & Reserve Affairs)
Chief of Naval Research
Chief of Naval Personnel
Industrial College of the Armed Forces
Armed Forces Staff College
Navy Personnel Research & Development Center
U. S. Naval Academy
Naval Postgraduate School
Naval War College
Naval History Division (Op-09BH)
Systems Analysis Division (Op-96)
Naval Education and Training (Op-099)
DCNO (Manpower) (Op-01)
Commander, Naval Recruiting Command
Naval Recruiting Command (Code 21)
Director of Defense Program Analysis & Evaluation (OSD)
Defense Documentation Center (12)
Institute for Defense Analyses
Human Resource Research Organization
The Mitre Corporation
The RAND Corporation
Stanford Research Institute
University of Rochester (2)

CENTER FOR NAVAL ANALYSES

RESEARCH CONTRIBUTION 247

Institute of Naval Studies

METHODOLOGY FOR USING DRAFT LOTTERY DATA TO ESTIMATE TRUE VOLUNTEERS

May 1973

Christopher Jehn
Hugh E. Carroll, II, LCdr., U.S.N.

This Research Contribution does not necessarily represent the opinion of the Department of the Navy.

Work conducted under contract N00014—68—A—0091

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

ABSTRACT

Methodologies for estimating true volunteers were evaluated using draft lottery data. An appropriate method was identified for predicting the supply of first term enlistees in a draft free environment.

TABLE OF CONTENTS

Abstract i

Methodology for using draft lottery data to estimate true volunteers 1

Introduction 1

Method 1

Numbered group 1

Unnumbered group 2

Empirical results 5

Summary and conclusions 9

METHODOLOGY FOR USING DRAFT LOTTERY DATA TO ESTIMATE TRUE VOLUNTEERS

INTRODUCTION

The introduction of a draft lottery in CY-70 created a new and extremely useful set of data for the analysis of defense manpower problems, especially those concerning the supply of first-term enlistees. Perhaps the most useful application of this data is in the estimation of the percentage of first-term enlistees who are true volunteers, that is, individuals who would enlist even in the absence of a draft. Although the draft has now ended, it will be several years before enough observations from this draft-free environment are available to allow thorough analysis of questions such as those concerning the use of recruiting resources and possible recruiting problems in the absence of a draft. In the meantime, the lottery data can serve this purpose.

This paper describes a methodology for using the lottery data and comments on its previous uses (and misuses). In particular, we test the assumptions upon which previous lottery data estimates of volunteer rates have been based.

METHOD

Prior to the introduction of the draft lottery, estimates of the degree of true voluntarism among first-term enlistments were based on various DOD surveys that asked first-term enlistees to describe their enlistment motivation. Aside from the problems inherent in such surveys, an additional flaw in most of the studies that were based on this survey data is their assumption that no draftees would have volunteered in the absence of a draft. Both of these difficulties are avoided by using the lottery data, although several others are created that have not been addressed to date.

For the purposes of this discussion, an enlistee (or draftee) can be placed in one of three groups. The first group, those whose draft liability is essentially over, are virtually all true volunteers. The second group, composed of individuals who were draft liable and knew their draft lottery number at the time of enlistment, we will refer to as the "numbered" group. (In practice, because of the limitations of the actual enlistment data, it is usually difficult or impossible to identify individuals who belong in the first group. In that event, these people must also be grouped in this second group. This expediency probably produces only negligible errors). The third group, those who enlisted before their lottery numbers were drawn, we will refer to as the "un-numbered" group.

Numbered Group

For the numbered group, the estimation of the rate of true voluntarism should be relatively straightforward. At the time of the first lottery draw (1 December 1969), Selective Service officials were widely quoted to the effect that individuals with very low numbers (e.g., 1-100) were almost certain to be drafted, while those with very high numbers (e.g., 240 and up) would almost certainly not be drafted. Thus, individuals with very high lottery numbers should feel no draft pressure, and we can assume all volunteers in this group were true volunteers. We can also assume that the

propensity to enlist is uncorrelated with birth date, and therefore the rate of voluntarism among all numbered individuals is the same as for the group having very high numbers. Thus, a count of those volunteers with numbers in the high third of the distribution (lottery numbers 241 and up) will result in a number one-third as large as the total number of true volunteers.

This technique has been applied by all users of the lottery data. All individuals with lottery number 241 or higher are counted as true volunteers, and their sum is multiplied by 2.9 (= 365/125) to arrive at a total for the numbered group. Although this method is relatively straightforward, some care must still be taken in applying it. First, the chosen cutoff number must be high enough to reasonably insure that no individuals with higher numbers felt any draft pressure. For national estimates, 241 is probably high enough. In 1970, no local board reached a number higher than 195, while in 1971 the actual cutoff number was 125. However, when constructing estimates for specific geographical areas in 1970, a higher cutoff might be necessary. During 1970, some local boards approached lottery number 195 fairly early in the year so that some individuals with lottery numbers well into the 200s may have felt draft pressure, especially before the uniform national cutoff number (195) was announced. Since these local boards were few in number, this problem produces negligible errors for national estimates.

The most obvious technique for assessing the validity of a chosen cutoff number involves examining the distribution of enlistments by lottery number. Enlistments should be highest for the lowest lottery numbers and taper off as lottery number rises. A hypothetical example of such a distribution is shown in figure 1. The chosen cutoff in this example must be no lower than c to provide an accurate estimate of the number of true volunteers. (Figure 2 shows the actual distribution for FY-71.) This technique lends itself to making estimates for individual geographical areas as well as the entire country.

It is important, however, not to make too much of this sort of analysis. While a distribution such as that shown in figure 1 indicates that the propensity to enlist does not change with lottery number above c, it does *not* imply that individuals with lottery numbers above c do not feel any draft pressure. It is still possible that the height of the rectangle labeled "true volunteers" might vary with draft pressure. That is, while an individual with lottery number 241, for example, may behave no differently than a similar individual with lottery number 365, both may respond to changes in draft pressure. Thus, the important question here is the degree to which individuals in the upper third of the lottery distribution respond to changes in draft pressure. We present some empirical results in the next section which shed light on this issue.

Unnumbered Group

The estimation of true volunteers in the unnumbered group has been somewhat more confused. Previous estimates have usually been based on one of two assumptions: (1) unnumbered individuals do not feel or respond to draft pressure, or (2) unnumbered individuals respond to draft pressure in precisely the same fashion as numbered individuals. Under the first assumption, 100 percent of enlistments of unnumbered individuals should be counted as true volunteers. Under the second assumption, the ratio of true volunteers to total enlistments for numbered individuals (with

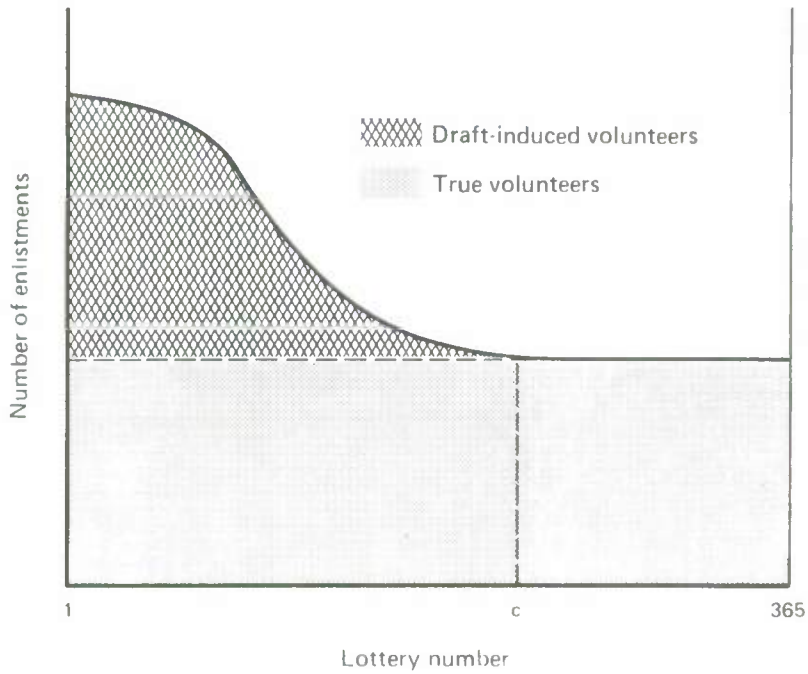

FIG. 1: DISTRIBUTION OF ENLISTMENTS BY LOTTERY NUMBER

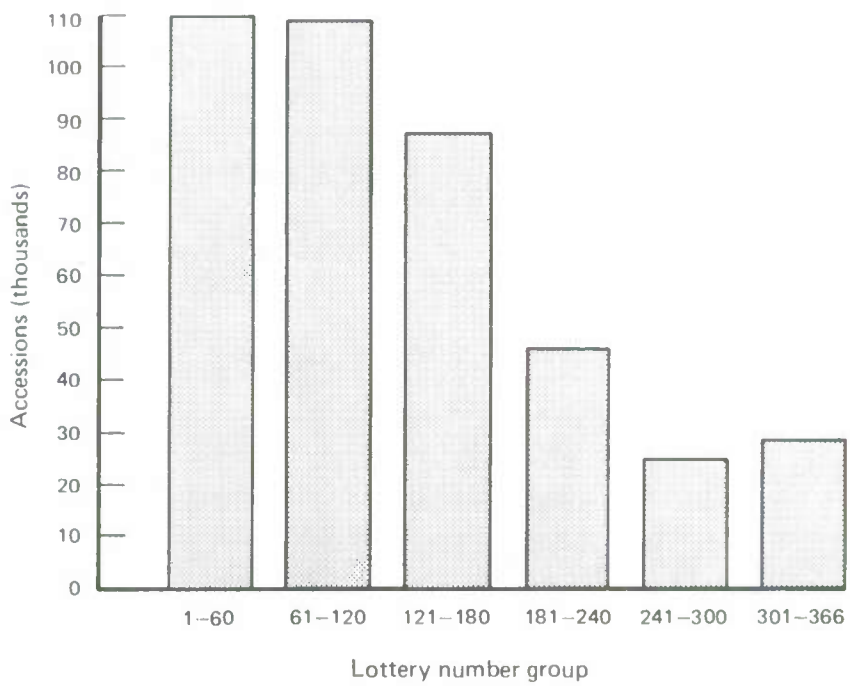

FIG. 2: TOTAL ACCESSIONS, ALL DOD, BY LOTTERY NUMBER, FY-1971

true volunteers in the numbered group estimated as described above), multiplied by total unnumbered enlistments, will provide an estimate of the number of true volunteers in the unnumbered group.

Since we are interested in understanding the behavior of those in the unnumbered group, consider the possible "lifetimes" such an individual faced at the time of enlistment. Call "A" that lifetime where he never serves in the military, i.e., he neither enlists nor is drafted. Call "B" that lifetime where the individual enlists before he knows his draft lottery number. Call "C" that lifetime where he waits for his lottery number to be drawn, the Selective Service System reaches his number, and he chooses to enlist rather than be drafted; and call "D" that lifetime where he waits, his number is reached, and he is drafted. These alternatives are summarized below.

A: No military service
B: Enlist now (before lottery number is drawn)
C: Lottery number is reached and enlist
D: Lottery number is reached and be drafted

Assume the individual can assign utilities to these alternatives so he is comparing U(A), U(B), U(C), and U(D) (where U( ) is read "utility of"), or, more generally, he compares U(A), U(B), and U(C′) where U(C′) = max [U(C), U(D)]. These utility calculations would be based not only on military pay relative to civilian pay and tastes for military service, but also the advantages and costs of military service sooner rather than later, the cost of uncertainty associated with future draft liability, the difference in civilian earnings as a result of military service, and so on.

A true volunteer in the unnumbered group is someone for whom $U(B) > U(A)$. Under what circumstances does an unnumbered individual enlist when $U(A) > U(B)$? If he enlists now, he obtains utility U(B). If he waits for his lottery draw, he obtains utility equal to $(1-p)U(A) + pU(C')$, where p = the probability that his lottery number will be reached. He thus enlists when the expected utility from enlisting now exceeds that obtained by waiting, or when $U(B) > (1-p)U(A) + pU(C')$.

Since we know $U(A) > U(B) > U(C')$ (otherwise he waits regardless of p or U(A)), any individual in this situation is more likely to enlist the greater is draft pressure (p). In other words, enlistments by unnumbered individuals for whom $U(A) > U(B) > U(C')$ should rise (fall) as draft pressure rises (falls). Of course, the degree to which enlistments respond to changes in draft pressure (the elasticity of supply with respect to draft pressure) can only be determined empirically and will depend on the distribution of potential enlistees' tastes regarding the various "lifetimes" they face (i.e., A, B, C′).

Because draft pressure changed significantly between the beginning of 1970 and the end of the draft in January 1973, ignoring the fact that unnumbered enlistments might respond to this change could result in a systematic (although possibly small) bias in the estimation of the number of true volunteers. Thus, previous studies of enlistment behavior, which have ignored the responsiveness of unnumbered enlistments to changes in draft pressure, may well have produced biased results. This bias will lead to, at the very least, over- or underestimates of both the number of true volunteers in past periods and forecasts for future periods. In addition, if unnumbered individuals respond

differently than numbered individuals to changes in policy variables, such as military pay, bonuses, and enlistment options, estimates of the elasticity of enlistments with respect to these policy variables will also be biased. This is not a minor problem, since in some months enlistments by unnumbered individuals were as much as 50 percent of the total number of enlistments. Table 1 presents enlistments by unnumbered individuals as a percentage of total enlistments.

TABLE 1

UNNUMBERED ENLISTMENTS AS A PERCENTAGE OF TOTAL ENLISTMENTS FOR ALL SERVICES, BY MONTH, JANUARY 1970 TO AUGUST 1972

	1970	1971	1972
January	34.4	28.6	45.0
February	32.5	29.0	21.5
March	31.5	33.0	27.3
April	28.6	34.7	25.5
May	25.9	33.2	31.5
June	37.0	55.7	37.2
July	24.0	68.8	39.5
August	27.7	43.6	37.6
September	27.7	42.1	
October	30.8	37.1	
November	33.9	33.5	
December	33.7	40.4	

graduation

Source: U.S. Army Recruiting Command Files

As in the case of numbered individuals in the upper third of the lottery distribution, it is important to ascertain the degree of responsiveness of enlistments by unnumbered individuals to changes in draft pressure. Without this information, estimates of the rate of true voluntarism may be biased. Empirical results relating to this question are presented below.

EMPIRICAL RESULTS

As discussed above, using the draft lottery data to estimate the number of enlistments of true volunteers requires information about the responsiveness to draft pressure of two groups of enlistees: numbered individuals in the upper third of the lottery distribution and unnumbered individuals. In particular, other things remaining the same, what would enlistments by individuals in each of these two groups have been had the draft not existed? Have enlistments by either unnumbered individuals or those in the upper third of the lottery distribution responded to changes in draft pressure? To answer this question, we estimated a supply function for each of these two groups, where the arguments in the supply function were pay, unemployment, numbers of recruiters, advertising expenditures, time dummies, and a draft pressure variable. The dependent variables, enlistments of numbered individuals in the upper third of the lottery distribution and enlistments of unnumbered individuals, were expressed as rates and were restricted to include only individuals falling in mental categories I, II, and upper III. This restriction was adopted to

maximize the likelihood that the observed values of the dependent variables were on the supply surface. Even in periods of great excess supply, it is unlikely that the services were turning away individuals in the upper mental categories. The theory underlying this technique for estimating recruit supply functions has been described in detail in previous studies of enlistment behavior.*

The specific results reported here were derived from the estimation of a function having the form

$$\ell n\left(\frac{E}{P_t}\right) = b_0 + b_1 \ell n W_t + b_2 \ell n U_t + b_3 \ell n R_t + b_4 \ell n A_t + b_5 \ell n D_t + \sum_{i=6}^{8} b_i T_i + e_t \quad (1)$$

The variables were defined as follows:

E = monthly enlistments, all services, in mental groups I, II, and III_U. The data was taken from tapes prepared from U.S. Army Recruiting Command files for accessions to all four services from January 1970 to August 1972.

P = population defined as 17-20 year-old noninstitutionalized civilian males. The data was obtained from unpublished population estimates of the U.S. Bureau of the Census which are consistent with "Current Population Reports," Series P-25, Nos. 483 and 490, and estimates of the institutional population which are consistent with the 1970 census.

W = relative wages defined as the ratio of discounted expected military earnings to discounted civilian earnings over a four-year period. Expected military earnings was computed by weighting regular military compensation by the distribution of all enlisted men by pay grade through the first four years of service. Expected civilian earnings was based on the usual weekly earnings of 17-20 year-old civilian males in the full-time labor force as of May 1969, 1970, and 1971, from "Current Population Survey" tabulations (unpublished). Interpolations and extrapolations for other months were based on changes in weekly manufacturing earnings from U.S. Bureau of Labor Statistics, "Employment and Earnings."

U = employment variable = 1-u where u is the unemployment rate of 17-20 year-old civilian males with major activity other than school. Data is from the "Current Population Survey" monthly tabulations, table 7 (unpublished).

R = enlisted canvassers on duty, all services. Data was obtained from the personnel departments of the respective recruiting commands.

A = advertising expenditures, annual rate, all services. Data was obtained from the Central All-Volunteer Task Force (OASD/M&RA).

D = draft pressure variable = $1 - \frac{d}{p}$ where d is monthly inductions. Data was obtained from the Selective Service Systems

T = seasonal time dummies.

e = error term.

*See, for example, the papers by Gray and Fechter in *Studies Prepared for the President's Commission on an All-Volunteer Armed Force*, Washington, D.C.: USGPO, November 1970.

The t subscripts refer to monthly time periods from January 1970 to August 1972. Equation (1) was estimated both for numbered individuals in the upper third of the distribution and for unnumbered individuals. In either case, of course, E and P were adjusted accordingly.

Several alternative formulations of the draft pressure variables can be justified. Should it, for example, be entered as a rate (as we have done), or as simply the number of inductions? (Monthly inductions for the time period we studied are presented in table 2.) If it is entered as a rate should the denominator, P, be the numbered eligibles or some larger group such as all 17-20 year olds? These are empirical questions which cannot be resolved by appealing to theory. In the results presented below, the draft pressure variables were entered as the complement of the induction rate with P defined as the population of 17-20 year-old noninstitutionalized civilian males. The results were not affected, however, when the draft pressure variable was entered in other forms.

TABLE 2

INDUCTION, BY MONTH, JANUARY 1970 TO AUGUST 1972

	1970	1971	1972
January	11,353	20,634	134
February	14,413	19,475	102
March	13,284	13,595	129
April	15,897	9,684	3,830
May	18,635	12,362	1,892
June	18,985	7,931	8,546
July	18,611	34	6,264
August	13,343	4	9,050
September	12,275	32	
October	9,681	521	
November	8,995	7,520	
December	7,274	2,529	

As equation (1) is written, all variables are entered contemporaneously. In addition, a variety of time lags and lag structures were also examined. Many of these regression results are presented in tables 3 and 4. In all cases presented in the tables, the draft pressure variable was entered as shown, while all other variables were entered contemporaneously. The figures in the column labeled $\hat{\beta}$ are the regression coefficients on the draft pressure variables $(1 - \frac{d}{p})$, t = the t-statistics for these coefficients, F = F-statistic for the equation; the last column contains the R^{-2}-statistic for the equation.

The results shown are consistent with the hypothesis that draft pressure has not affected either enlistments by unnumbered individuals or enlistments by numbered individuals in the upper third of the lottery distribution. In no case is the coefficient on draft pressure significant at the 5 percent level. Further, recalling from equation (1) that draft pressure was entered in complement form, we note that in most cases the sign of the coefficient is "wrong." That is, the positive signs, if they are taken seriously, suggest that as draft pressure rises, enlistments fall. This is, of course, exactly the opposite of what one would expect. Finally, and perhaps most importantly, when these

TABLE 3

REGRESSION RESULTS: THE EFFECT OF DRAFT PRESSURE ON ENLISTMENTS OF NUMBERED INDIVIDUALS IN THE UPPER THIRD OF THE LOTTERY DISTRIBUTION

Regression No.	How entered	$\hat{\beta}$	t	F	R^2
1	Contemporaneously	20.3	.41	5.85	.67
2	Lagged one month	39.6	.91	6.81	.71
3	Lagged two months	-35.1	-.69	7.32	.74
4	Lagged three months	-34.8	-.59	7.16	.74
5	Preceded one month	-47.2	.94	5.30	.66
6	Preceded two months	36.4	.67	4.78	.65
7	Preceded three months	21.8	.33	4.71	.65
8	Distributed lag, contemporaneous observations	-11.1	-.28	6.96	.75
9	Six-month past average	30.1	.25	6.81	.75
10	Six-month future average	213.9	1.70	5.40	.71

TABLE 4

REGRESSION RESULTS: THE EFFECT OF DRAFT PRESSURE ON ENLISTMENTS OF UNNUMBERED INDIVIDUALS

Regression No.	How entered	$\hat{\beta}$	t	F	R^2
1	Contemporaneously	1.13	.03	12.9	.82
2	Lagged one month	-14.9	-.28	12.4	.82
3	Lagged two months	56.1	.93	16.1	.86
4	Lagged three months	101.7	1.87	19.6	.89
5	Preceded one month	20.2	.44	11.2	.80
6	Preceded two months	-7.1	-.15	9.5	.78
7	Preceded three months	-3.5	-.08	9.1	.78
8	Distributed lag, contemporaneous observations	-6.1	-.14	14.04	.86
9	Six-month past average	88.7	.59	13.1	.85
10	Six-month future average	79.1	1.04	8.26	.79

regressions were run in stepwise fashion, the draft pressure variable was usually the last to enter and explained much less than one percent of the variance in the dependent variable.

While the results presented in tables 3 and 4 were all based on regressions run in the log-linear functional form of equation (1), other functional forms were also used. Results were all consistent with those presented in tables 3 and 4. The same was true of the results of regressions using different forms and lag structures on independent variables other than draft pressure.

In short, the results lead us to conclude that neither unnumbered individuals nor numbered individuals in the upper third of the lottery distribution have responded in any measureable way to changes in draft pressure. Thus, in the absence of any other evidence, 100 percent of the individuals in both groups should be counted as true volunteers.

SUMMARY AND CONCLUSIONS

While the draft lottery data has been used for some time for the purpose of estimating the numbers of true volunteers, no investigators to date have evaluated the different techniques for doing so. Our results cast light on this issue. In particular, given current evidence, the appropriate technique is as follows:

1. Count 100 percent of unnumbered individuals as true volunteers.
2. Count all numbered individuals in the upper third of the lottery distribution as true volunteers, and multiply this number by 2.9 ($= \frac{365}{125}$) to arrive at a total for all numbered true volunteers.

Although this technique should produce reasonably accurate estimates of the number of true volunteers, one final caveat is in order. These numbers should not be viewed as the maximum obtainable given a fixed environment of military pay and other policy variables. In other words, these numbers must *not* be viewed as observations necessarily lying on a supply curve or surface. During periods of high draft pressure, the services were undoubtedly "creaming," that is, substituting draft-induced volunteers with high AFQT scores for true volunteers with lower AFQT scores. Thus, the number of enlistments of true volunteers in these periods of demand constraint is less than what would have been obtained had the services accepted all qualified individuals. Any estimate of supply based on these numbers. then, must allow for this possibility.

This is especially true when estimates of the effectiveness of recruiting resources, such as advertising and active canvassers, are sought. Because these recruiting resources facilitate the creaming process and are also the means by which creaming occurs, biased estimates of the effectiveness of advertising or additional recruiters may result. Any study which ignores this demand constraint problem, or makes no effort to estimate its effect, should be viewed with suspicion.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Center for Naval Analyses

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
Methodology for Using Draft Lottery Data to Estimate True Volunteers

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5. AUTHOR(S) *(First name, middle initial, last name)*

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
May 1973	13	1

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
N00014-68-A-0091	
b. PROJECT NO.	CRC 247
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office of Naval Research Department of the Navy Washington, D.C. 20350

13. ABSTRACT

Methodologies for estimating true volunteers were evaluated using draft lottery data. An appropriate method was identified for predicting the supply of first term enlistees in a draft free environment. Although the method should produce reasonably accurate estimates of the number of true volunteers, periods of demand constraint must be considered in the analysis.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6801

Unclassified
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
military personnel						
military draft						
draft lottery						
recruitment						
enlistment						
volunteers						

CENTER FOR NAVAL ANALYSES

1401 Wilson Boulevard
Arlington, Virginia 22209